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## **GUJARAT TECHNOLOGICAL UNIVERSITY** BE - SEMESTER- VIII<sup>TH</sup> EXAMINATION – SUMMER 2015

Subject Code: 183502Date:11/05/2015Subject Name: Chemical Kinetics & Reaction EngineeringTotal Marks: 70Time: 10.30-01.00Total Marks: 70Instructions:Total Marks: 70

- 1. Attempt all questions.
- 2. Make suitable assumptions wherever necessary.
- 3. Figures to the right indicate full marks.
- Q.1 (a) Discuss wide world of application of Chemical Kinetics Reaction Engineering.
  (b) Define reaction rate. Explain Molecularity and order of reaction giving typical 07 example.
- Q.2 (a) What is significance of activation energy? Explain temperature dependency of 07 reaction rate constant from Arrhenius law.
  - (b) List various methods for finding order of reaction, explain any one in detail. 07

(b) The thermal decomposition of hydrogen iodide is reported by M. Bodenstein, 07

$2\Pi \longrightarrow \Pi_2 + \Pi_2$									
Т, <sup>0</sup> С	508	427	393	356	283				
K, cm <sup>3</sup> /mol.s	0.1059	0.00310	0.000588	80.9 * 10 <sup>-6</sup>	0.942*10 <sup>-6</sup>				
Find the complete rate equation for this reaction.									

Q.3 (a) The laboratory measurements of the rate v/s conversion for the reactant A are given 07 below:

X <sub>A</sub>	0	0.20	0.4	0.6	0.8	
$-\mathbf{r}_{\mathrm{A}}, mol/(l.s)$	0.182	0.143	0.10	0.0667	0.0357	

Compare the volumes of CSTR and PFR required to achieve 60% conversion. The feed conditions are the same in both cases and molar flow rate of entering the reactor is 10 mol/s.

OR

- (b) Derive the performance equation for steady-state plug flow reactor.
- Q.3 (a)

<b>t</b> , (min)	0.5	1	1.5	2	2.5	3	3.5	4	5	6	7	8
С <sub>А</sub> , (mol/l)	0.026	0.021	0.018	0.015	0.0131	0.0114	0.01	0.009	0.0072	0.0059	0.005	0.0041

Using differential method of analysis, Find order of reaction and rate constant.

(b) Derive the performance equation for steady-state Mixed flow reactor.

Q.4 (a) Write a short note on "Heats of reaction from thermodynamics".

(b) Define selectivity. Discuss about quantitative treatment for plug flow reactor when 07 reactions in series.

OR

Q.4 (a) What is equilibrium conversion? Discuss the effect of temperature on equilibrium 07 conversion at constant pressure and effect of pressure and inert on equilibrium conversion at constant temperature.

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- (b) With respect to reaction in parallel. Explain case (1)  $\alpha_1 > \alpha_2$  and  $\beta_1 > \beta_2$ , case (2)  $\alpha_1 > \alpha_2$  07 and  $\beta_1 < \beta_2$ , case (3)  $\alpha_1 < \alpha_2$  and  $\beta_1 > \beta_2$ .
- Q.5 (a) Describe briefly about Catalyst, Promoters, Inhibitors and poisons with an example 07 of each.
  - (b) Toluene is adsorbed on the surface of catalyst and reacts with hydrogen in gas phase 07 to produce benzene adsorbed on the surface and CH<sub>4</sub> in the gas phase. Benzene is then desorbed from the surface. The proposed mechanism is: Adsorption: T<sub>(g)</sub> +S = T ⋅ S Surface reaction: T ⋅ S = B ⋅ S + M<sub>(g)</sub> Desorption: B ⋅ S = B<sub>(g)</sub> + S Overall reaction of hydrodemethylation of toluene is C<sub>6</sub>H<sub>5</sub>CH<sub>3</sub> + H<sub>2</sub> → C<sub>6</sub>H<sub>6</sub> + CH<sub>4</sub> T (g) + S → B<sub>(g)</sub> + M<sub>(g)</sub> Derive a rate expression when surface reaction is rate controlling step. OR
- **Q.5** (a) Write a short note on Catalyst Deactivation.
  - (b) Explain Langmuir-Hinshelwood kinetics for fluid-solid catalyzed reaction. 07

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